

Listing of Claims:

1. (Currently Amended) A method of using ultrasound waves focused at a specific location in a medium to cause localized production of ~~bubbles~~ microbubbles at said location, to control said production, and to control ~~the~~ cavitation and heating effects that take place at said location, the method comprising:

~~;~~ wherein, said production and control is accomplished by

providing multiple ultrasonic transducers;
focusing the transducers at said location;
simultaneously directing ultrasound waves from the
transducers at said location; and

selecting ~~the~~ a range of parameters of the ultrasound waves
being directed from the multiple transducers focused at said
location in order to improve a likelihood of cavitation, and to
produce from interference of the ultrasound waves at said
location one of ~~the waveforms~~ chosen from the following group:

a waveform comprising high negative peaks and small
positive peaks, said waveform encouraging the creation of a cloud
of microbubbles;

a waveform encouraging ~~the~~ production of heat and ~~the~~
limitation ~~the~~ of growth and possible implosion of ~~said the~~
microbubbles; and

a combined waveform comprising a spatial and/or
temporal combination of two waveforms - one waveform comprising

high negative peaks and small positive peaks and the second waveform comprising high positive peaks and only small negative peaks, said combined waveform allowing control of ~~the~~ size distribution of the microbubbles and temporal changes of ~~this~~ the distribution.

2. (Currently Amended) A method according to claim 1, wherein the waveform encouraging the production of heat is ~~chosen from the group comprising~~ one of:

a waveform comprising high positive peaks and only small negative peaks; and

a sinusoidal waveform.

3. (Currently Amended) A method according to claim 2, wherein the waveform comprising high positive peaks and only small negative peaks encourages ~~the~~ reduction of the size of said microbubbles.

4. (Currently Amended) A method according to claim 1, wherein ~~the~~ a number of the transducers is three.

5. (Currently Amended) A method according to claim 1, wherein ~~the~~ a radius of the microbubbles is in ~~the~~ a range from a

fraction of a micron up to 100 or more microns, and preferably between approximately 3 microns to 5 microns.

6. (Currently Amended) A method according to claim 1, wherein a control system measures ~~the~~ changes in tissue or ~~the bubbles~~ microbubble size and accordingly adjusts the waveform to include more negative peaks, more positive peaks, or more equal sized waves.

7. (Currently Amended) A method according to claim 1, wherein further comprising a temperature control system ~~is used to modify the~~ that modifies an output of the transducers according to ~~the~~ measured temperature.

8. (Currently Amended) A method according to claim 1, wherein further comprising an ultrasound imaging or non-imaging system ~~is used to view and monitor~~ that views and monitors the region being targeted, ~~to monitor the~~ monitors generation of the microbubbles at the desired location, and ~~control~~ controls the system for one or more of the following purposes:

so that ~~the~~ a number of microbubbles will be as planned;
for aiming ~~the~~ a focused beam to the targeted location; and
to re-align the beam to a different location.

9. (Currently Amended) A method according to claim 8, wherein ~~the~~ a response at ~~the~~ a half harmonic or at higher harmonics of the transmitted frequencies is used by the ultrasound imaging or non-imaging system to measure one or more of the following:

- ~~the~~ effect of the heating;
- ~~the~~ duration of said effect;
- ~~the~~ number of microbubbles generated within the targeted region; and
- ~~the~~ spatial distribution of said microbubbles generated within said targeted region.

10. (Currently Amended) A method according to claim 1, wherein the multiple transducers are arranged as an array, designed so that their mechanical focus and their own focus combine at ~~the~~ a same point in space.

11. (Currently Amended) A method according to claim 10, wherein the point in space can be moved by either shifting the whole array, by repositioning of individual transducers, or by phase shift of ~~the~~ an excitation pulse.

12. (Currently Amended) A method according to claim 10, wherein the ~~ultrasonic~~ ultrasound waves transmitted by the

different transducers are designed to produce by interference specific waveforms at ~~the~~ a focal point, which are not produced at other locations.

13. (Original) A method according to claim 12, wherein the specific waveforms can be modified to produce one of the following effects:

cause cavitation with no significant change in temperature;
increase the temperature with minimal cavitation;
suppress cavitation; and
a combination of these effects.

14. (Currently Amended) A method according to claim 12, wherein ~~the~~ a region within ~~the~~ a focal zone of all the transducers in which the specific waveform develops at significant intensities and ~~the~~ amplitudes of the waveforms are less than -3 DB of ~~the~~ a maximum amplitude, are typically at distances less than 25 mm and preferably less than 1 mm away from ~~the~~ a point of said maximum amplitude in ~~the~~ lateral directions and less than 10 mm and preferably less than 1.5 mm away in ~~the~~ axial directions.

15. (Currently Amended) A method according to claim 1, wherein ~~the~~ localized production of ~~bubbles~~ microbubbles at the

location and control of the cavitational and heating effects that take place at said location are for therapeutic purposes.

16. (Currently Amended) A method according to claim 1, wherein the array is placed extra-corporally, in close proximity to ~~the~~ an organ to be treated, with ultrasound gel or water surrounding the ultrasound transducers and ~~the~~ space between it and the organ.

17. (Currently Amended) A method according to claim 15, wherein the therapy is ~~chosen from the following group~~ at least one of:

occlusion of varicose veins and telangiectasia;

activation of cellular ~~(e.g. endothelial cell)~~ processes in ~~the~~ a body, by either localized pressure forces or shear forces that produce therapeutic responses or damage;

therapy of cancerous tissue by cavitation damage and/or rapid hyperthermia, resulting in apoptosis, tissue ablation or necrosis;

therapy of cancerous tissue by damage and closure of ~~the~~ supply and drainage vasculature by cavitation, and/or rapid hyperthermia via coagulation of ~~the~~ arteries supplying ~~the~~ a tumor;

ablation of ectopic foci or re-entry loops within ~~the~~ cardiac walls, mainly within ~~the~~ ventricular walls;

thrombolysis of clotted or semi-clotted arteries, ~~e.g.~~
~~coronary arteries, the carotid arteries, cerebral arteries,~~
~~peripheral arteries etc.~~ lipolysis or other methods of
disintegration of fat cells, either by ~~the~~ a mechanism of
microbubbles collapse and/or by hyperthermia, resulting in
apoptosis and drainage of fat deposits;

coagulation of internal bleedings within the body; and
non-invasive surgery of internal tissues and organs, by
disintegration of cells along ~~the~~ a cut.

18. (Currently Amended) A method of occluding varicose
veins ~~and telangiectasia according to claim 17,~~ comprising the
steps of:

a) ~~providing multiple transducers;~~ b) focusing ~~said~~ multiple
transducers at ~~the~~ a same location within ~~said~~ a vein;

~~c)~~ b) selecting ~~the~~ a range of parameters of said multiple
transducers to produce a waveform comprising high negative peaks
and small positive peaks, said waveform encouraging ~~the~~ creation
of a cloud of microbubbles;

~~d)~~ c) continuing ~~the~~ production of the waveform until ~~the~~
cavitation causes destruction of cells and ~~the~~ initiation of
scaring of ~~the~~ tissue at said location;

~~e)~~ d) focusing said transducers at another location within
said vein;

~~f)~~ e) repeating steps ~~(c), (d), and (e)~~ (b), (c) and (d) until enough scaring has been initiated to cause occlusion of said vein.

19. (Currently Amended) A method according to claim 18, wherein two additional steps are added between steps ~~(d) and (e)~~ (c) and (d), said steps comprising:

~~g)~~ f) changing the range of parameters of the multiple transducers to produce a heating waveforms, said waveform encouraging ~~the~~ production of heat at the location; and

~~h)~~ g) continuing the production of the waveform until the heating causes destruction of cells and ~~the~~ initiation of scaring of the tissue at said location.

20. (Currently Amended) A method according to claim 17, wherein activation of cellular processes in the body produces therapeutic responses or damage, ~~selected from the following group~~ including at least one of:

localized drug delivery,
gene therapy, and
angiogenesis.

21. (Currently Amended) A method according to claim 17, wherein thrombolysis of clotted or semi-clotted arteries is

performed in arteries chosen from ~~the group comprising~~ at least one of:

coronary arteries,
~~the~~ carotid arteries,
cerebral arteries, and
peripheral arteries.

22. (Original) A system for carrying out the method of claim 1, said system comprising:

three or more arbitrary waveform signal generators;
three or more wide-band power amplifiers;
three or more transducers; and
one workstation.

23. (Currently Amended) A system according to claim 22, wherein the three or more transducers are arranged as an array, designed so that their mechanical focus and their own focus combine at ~~the~~ a same point in space.

24. (Currently Amended) A system according to claim 23, wherein the point in space can be moved by either shifting the whole array, by repositioning of individual transducers, or by phase shift of ~~the~~ an excitation pulse.

25. (Currently Amended) A system according to claim 23, wherein the ~~ultrasonic~~ ultrasound waves transmitted by the three or more transducers are designed to produce by interference specific waveforms at ~~the~~ a focal point, which are not produced at other locations.

26. (Original) A system according to claim 25, wherein the specific waveforms can be modified to produce one of the following effects:

cause cavitation with no significant change in temperature;
increase the temperature with minimal cavitation;
suppress cavitation; and
a combination of these effects.

27. (Currently Amended) A system according to claim 25, wherein ~~the~~ a region within ~~the~~ a focal zone of all the transducers in which the specific waveform develops at significant intensities and ~~the~~ amplitudes of the waveforms are less than -3 DB of ~~the~~ a maximum amplitude, are typically at distances less than 25 mm and preferably less than 1 mm away from ~~the~~ a point of said maximum amplitude in ~~the~~ lateral directions and less than 10 mm and preferably less than 1.5 mm away in ~~the~~ axial directions.

28. (Original) A system according to claim 22, further comprising an ultrasound imaging or non-imaging system and a control box.

29. (Currently Amended) A system according to claim 28 ~~wherein further comprising~~ the ultrasound imaging or non-imaging system ~~is used to view and monitor~~ that views and monitors the region being targeted, ~~to monitor the~~ monitors generation of the microbubbles at the desired location, and ~~control~~ controls the system for one or more of the following purposes:

so that the number of microbubbles will be as planned;
for aiming the focused beam to the targeted location; and
to re-align the beam to a different location.

30. (Original) A system according to claim 28, wherein the response at the half harmonic or at higher harmonics of the transmitted frequencies is used by the ultrasound imaging or non-imaging system to measure one or more of the following:

the effect of the heating;
the duration of said effect;
the number of microbubbles generated within the targeted region; and
the spatial distribution of said microbubbles generated within said targeted region.

31. (Original) A system according to claim 28, wherein the ultrasound imaging or non-imaging system is controlled by the workstation to which it is connected through the control box.

32. (Currently Amended) A system according to claim 28, wherein the ultrasound imaging or non-imaging system measures the changes in tissue or the ~~bubbles~~ microbubbles size and the control box and workstation accordingly adjust the waveform to include more negative peaks, positive peaks or equal sized waves.

33. (Original) A system according to claim 22, further comprising a temperature measurement system.

34. (Original) A system according to claim 33, wherein the temperature measurement system comprises one or more thermocouples.

35. (Original) A system according to claim 33, wherein the temperature measurement system is used to modify the output of the transducers according to the measured temperature.

36. (Currently Amended) A system according to claim ~~22~~ 23, adapted for use in a therapeutic ~~procedures~~ procedure; wherein the array is placed extra-corporally, in close proximity to ~~the~~

an organ to be treated, with ultrasound gel or water surrounding the ultrasound transducers and the space between it and the organ.

37. (Currently Amended) A system according to claim 36, wherein the therapeutic procedure is ~~chosen from the following group~~ at least one of:

occlusion of varicose veins and telangiectasia;

activation of cellular ~~(e.g. endothelial cell)~~ processes in the body, by either localized pressure forces or shear forces that produce therapeutic responses or damage;

therapy of cancerous tissue by cavitation damage and/or rapid hyperthermia, resulting in apoptosis, tissue ablation or necrosis;

therapy of cancerous tissue by damage and closure of the supply and drainage vasculature by cavitation, and/or rapid hyperthermia via coagulation of the arteries supplying the tumor;

ablation of ectopic foci or re-entry loops within the cardiac walls, mainly within the ventricular walls;

thrombolysis of clotted or semi-clotted arteries, ~~e.g. coronary arteries, the carotid arteries, cerebral arteries, peripheral arteries etc.~~ lipolysis or other methods of disintegration of fat cells, either by the mechanism of

microbubbles collapse and/or by hyperthermia, resulting in
apoptosis and drainage of fat deposits;

coagulation of internal bleedings within the body; and
non-invasive surgery of internal tissues and organs, by
disintegration of cells along the cut.